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# Verifying ION8600 Meter Accuracy

All PowerLogic® ION8600 meters are tested and verified at the factory according to IEC (International Electrotechnical Commission) and ANSI (American National Standards Institute) standards; however, before a new revenue meter is installed it is important to perform a final accuracy verification.

ION meters are digital and do not require calibration, only verification of their accuracy. This technical note outlines a procedure for verifying the accuracy of ION8600 meters.

## In This Document



### Additional Information

- *ION8600 Installation Guide*
- *ION8600 User Guide*
- *ION Reference*

# Introduction

The revenue-accurate ION meter is digital and therefore needs no servicing. It is tested for accuracy at the factory and remains accurate for the life of the meter. In contrast, electro-mechanical meters need mechanical adjustment before installation and periodic calibration thereafter. This procedure is unnecessary for digital meters.

Digital meters require 'accuracy' testing, or verification to ensure the meter meets required accuracy specification. If you know your meter is within required accuracy specification before installation, errors observed in the field could be attributed to incorrect connections or instrument transformer ratio settings.

## Accuracy Standards and Current Ranges

The meter conforms to the following accuracy standards, depending on what current option is ordered:

| Current Input Order Option | Standard | Accuracy Range | Starting Current |
|---|---|---|---|
| C | IEC 62053-22 5A 0.2S (formerly IEC 60687 5A 0.2S) | 50 mA to 20 A | 5 mA |
| C | ANSI C12.20 current class 20 accuracy class 0.2 | 150 mA to 20 A | 5 mA |
| E | IEC 62053-22 1A 0.2S (formerly IEC 60687 1A 0.2S) | 10 mA to 10 A | 1 mA |
| | IEC 62053-22 5A 0.2S (formerly IEC 60687 5A 0.2S) | 50 mA to 10 A | |
| E | ANSI C12.20 current class 2 and 10 accuracy class 0.2 | 15 mA to 10 A | 1 mA |

**DANGER**

During operation, hazardous voltages are present on the terminals of the meter and throughout the connected test equipment and control power circuits.

• Only qualified, properly trained personnel should perform meter verification testing.

• Connect meter safety ground terminal to a low impedance safety ground system in all test configurations.

Failure to follow these instructions will result in severe injury or death.

## Testing Overview

The most common method for testing meters is to inject voltage and current from a stable power source and compare the meter energy readings with readings from a reference energy meter or energy standard. In general, it is recommended that a meter's accuracy be verified using a reference meter or an energy standard, rather than only the source of the test signal. Although meter shops use different methods for testing revenue meters, most test equipment requirements are similar.

The sections below provide an overview and some testing guidelines for verifying the accuracy of your ION8600.

### Test socket

A test socket is a convenient mounting device that fits socket-type meters. Ensure that the test socket for the meter or the mounting device is properly connected to the source of the test signal and the reference meter or standard.

The current and voltage transformers must be accurately rated and must perform within specifications to provide accurate results. Usually voltage or current transformers are not used in ION8600 meter verification testing.

### Power source

It is important to have a steady power source. Power that energizes the meter from the socket must be reliable and provide: the rated voltage of the meter, unity power factor (1.0) and lagging power factor of 0.0 (for VARh testing) or 0.5.

The ION8600 meter will maintain its accuracy during signal source variations, but its energy pulsing output needs a stable test signal to produce accurate test pulses. The meter energy pulsing mechanism needs approximately three to four seconds to stabilize after every source adjustment; the meter measurements are accurate during the signal source transitions, but the pulse output should be allowed to stabilize before the start of every test to ensure accuracy.

**NOTE**

In order to conduct verification testing of ION8600 meters powered from the voltage inputs, the source of the test signal should be capable of supplying sufficient power to the meter under test. With three phases present, typical per phase power consumption of the meter is: 5 VA/3.5 W at 120 V, 7 VA/4 W at 277 V. Please refer to the ION8600 technical specifications for more details.

### Test loads

There are three possible methods of current loading: in-situ load (a meter in service), resistance load (characteristics similar to a lighting load), and phantom loading (a test board). Your test load device or other loading circuit must be set within the current capacity ranges for the meter. The procedure outlined in this technical note describes verification using a phantom load or test board.

### Control equipment

Control equipment is required for counting and timing the pulse outputs (revolutions) from the front panel LEDs. Most standard test benches have an arm with optical sensors used for this purpose. Make sure the optical sensor can pick up red LED or infrared signals.

**NOTE**

The optical sensors on the test bench can be disrupted by strong sources of ambient light (such as camera flashes, fluorescent tubes, sunlight reflections, floodlights, etc.) and cause test errors.

### Environment

The meter should be tested at the same ambient temperature as the testing equipment. The ideal reference ambient temperature is typically 23$^{o}$C (73$^{o}$F). Ensure the meter is warmed up sufficiently before testing.

A warm up time of 30 minutes is recommended for ION8600 meters before energy accuracy verification testing. At the factory, the meters are warmed up to their typical operating temperature before calibration. This pre-calibration warm up ensures that ION8600 meters will reach their optimal accuracy at operating temperature.

Most high precision electronic equipment requires a warm up time before it reaches its specified performance levels. Both ANSI C12.20 and IEC62053-22 energy meter standards allow the manufacturers to specify meter accuracy de-rating due to ambient temperature changes and self-heating. The ION8600 accuracy de-rating specifications exceed the requirements of both the ANSI C12.20 and IEC62053-22.

### Grounding

**DANGER**

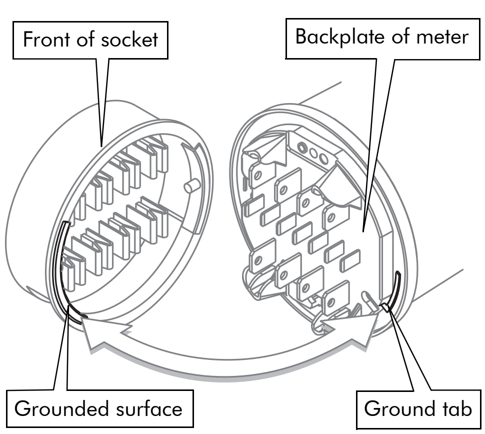
During operation, hazardous voltages are present on the terminals of the meter and throughout the connected test equipment and control power circuits.

- Only qualified, properly trained personnel should perform meter verification testing.
- Connect meter safety ground terminal to a low impedance safety ground system in all test configurations.

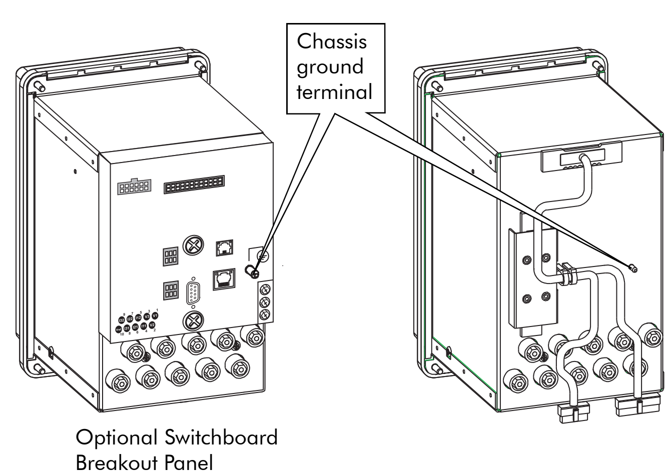
Failure to follow these instructions will result in severe injury or death.

The ION8600 meter’s safety ground terminal must be connected to a low impedance grounding system in order to avoid electric shock and to ensure that the meter's accuracy remains within specifications. The signal source and the reference meter (or energy standard) should also be grounded if recommended by their respective manufacturers.

**Socket Meter Ground Connection**




**Switchboard Meter Ground Connection**



**If the test configuration allows, the ION8600 meter's neutral voltage terminal should be grounded in any test configuration with unbalanced phase voltages, especially in the single-phase test configuration.**

### Reference Meter or Energy Standard

To ensure accuracy of the ION8600 verification test, it is recommended that a reference meter or a reference energy standard, with specified accuracy of ±0.025% or better, be used.

Before the start of testing, the reference meter or energy standard should be warmed up as recommended by its manufacturer.

**NOTE**

Ensure adequate accuracy and precision of any measurement equipment you use (i.e. voltmeters, ammeters, power factor meters).

## Using TEST Mode

When the meter is in TEST mode, separate test mode registers are used for test measurement accumulations so that the billing registers are not changed.

**NOTE**

If you have a hardware-locked meter you must remove the cover and manually press the TEST mode button. If your meter is not hardware-locked you can use ION Setup software to place the meter in TEST mode.

When you exit TEST mode all test measurements are reset to zero. The values shown on the TEST mode display screens include:

| Values | Description |
|---|---|
| kWh del T, kWh rec T | Test values of kWh delivered and kWh received |
| kVAR del T, kVARh rec T | Test values of kVARh delivered and kVARh received |
| kVAh del T, kVAh rec T | Test values of kVAh delivered and kVAh received |
| kW SD del T, kW SD rec T | Test values of Rolling Block (Sliding Window) Demand delivered and received |

# Test Procedure

### ⚠ DANGER

During operation, hazardous voltages are present on the terminals of the meter and throughout the connected test equipment and control power circuits.

• Only qualified, properly trained personnel should perform meter verification testing.

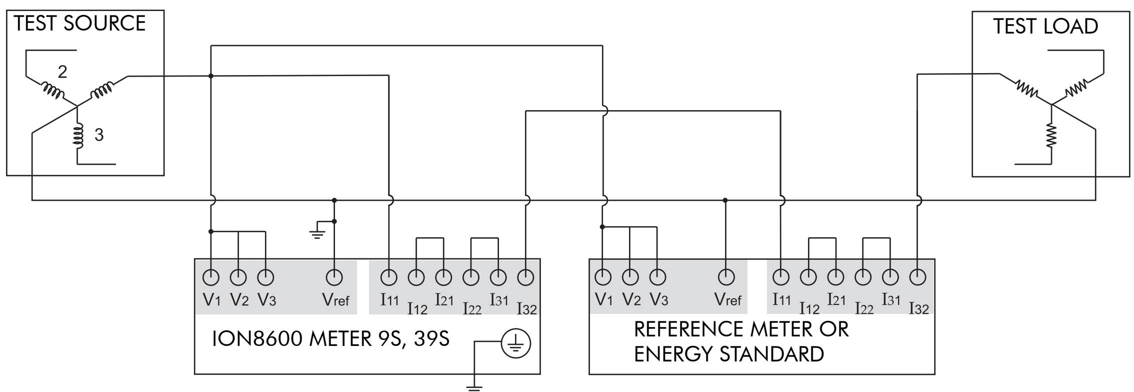
• Connect meter safety ground terminal to a low impedance safety ground system in all test configurations.

Failure to follow these instructions will result in severe injury or death.

## Single-Phase Test Configuration - 9S, 39S meters - Example

### NOTE

For optimum accuracy, the neutral voltage terminal of the meter should be grounded in the single-phase configuration.

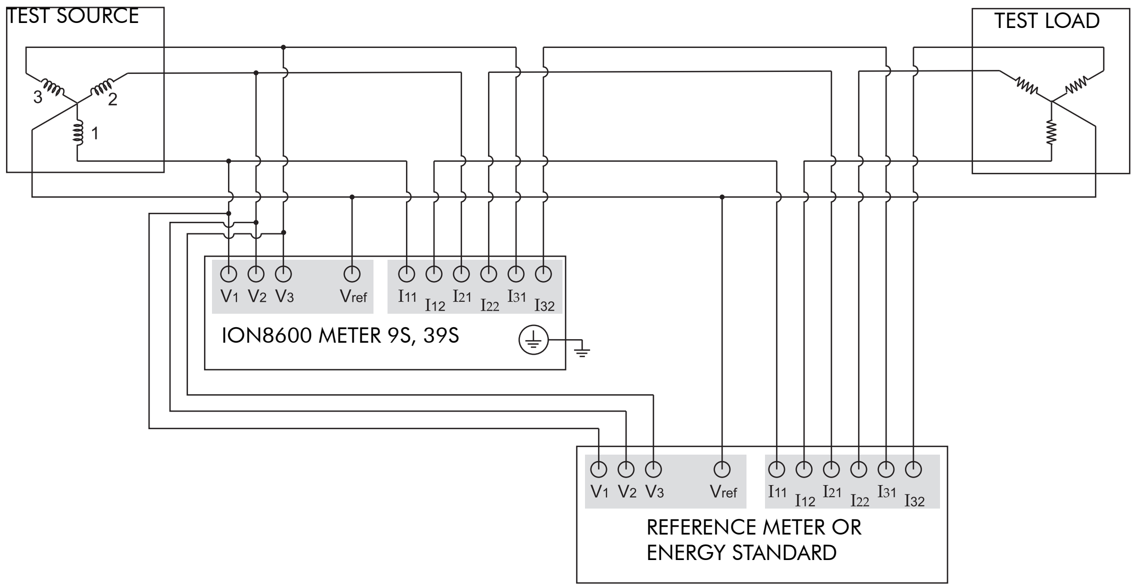


## Three-Phase Test Configuration - 9S, 39S meters - Example

**NOTE**

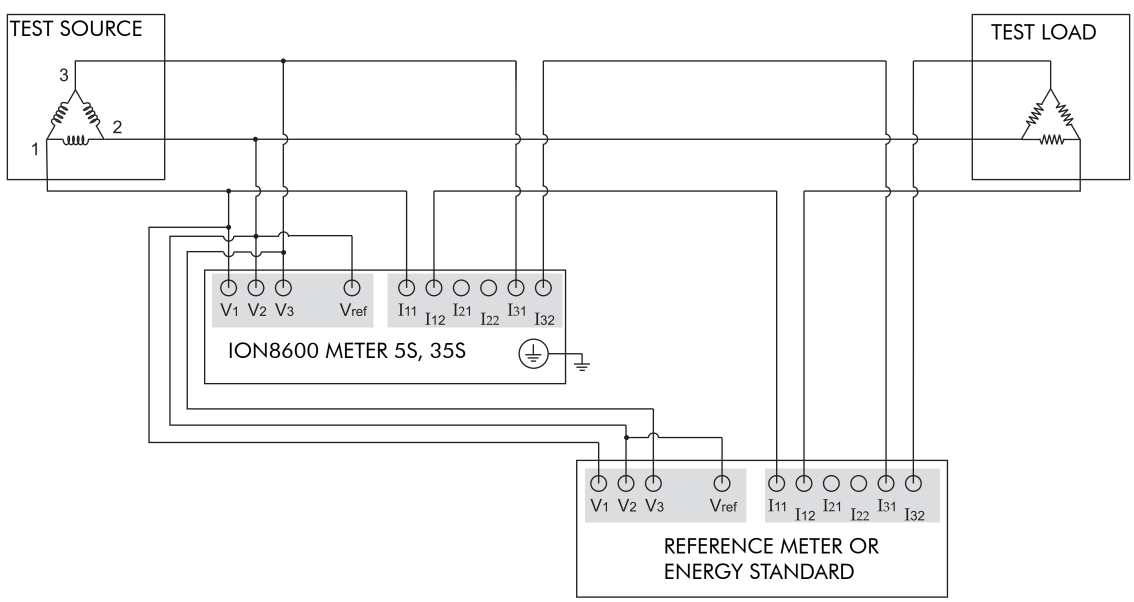
The neutral voltage terminal of the meter does not need to be grounded when the test source voltages are balanced.




## Three-Phase Test Configuration - 5S, 35S meters - Example

**NOTE**

The neutral voltage terminal of the meter does not need to be grounded when the test source voltages are balanced.



**NOTE**

All phases of the source used in a test should be connected to both the ION8600 and the reference meter.

**NOTE**

A warm up period of 30 minutes is recommended for ION8600 meters before the energy accuracy verification testing. During the warm-up time, the meter may be powered from any source (e.g. mains).

The following are guidelines for testing the meter. Your meter shop may have specific testing methods:

1. Place the meter into the test socket or other standard measuring device. For single-phase testing, ensure all voltages are in parallel with the meter being tested, all currents are in series, and the neutral voltage terminal of the meter is grounded.
2. Connect the control equipment used for switching the voltage to the test standard device.
3. Connect the control equipment used for counting the standard output pulses.
4. Apply the nominal current and voltage to the terminals of the meter.
5. Before performing the verification test, let the test equipment power up the meter; apply voltage for at least 30 seconds. The warm-up allows the internal circuitry to stabilize.
6. You may choose to place the meter in TEST mode. This allows the meter to enter the field with no Wh values in the registers. If you are performing field testing, put the meter in TEST mode to avoid incorrect customer billing.
7. Align the optical sensor on the standard test bench armature over the appropriate front panel LED pulser.

**TIP**

If the outer cover is still on the meter, align the meter sensor slightly off-perpendicular to the LEDs. This reduces reflections from the outer cover.
Also be aware that any flashing lights in the test area may reflect and register as pulses, affecting testing results.

8. Perform testing on all test points listed in the tables “Watt-hour test points - Example” and “VAR-hour points - Example” on page 12.
9. **Run each test point for at least 30 seconds to allow the test bench equipment to read an adequate number of pulses. Allow 10 seconds of dwell time between test points.** The number of pulses required for a test duration of **“**t**”** seconds can be determined using the following formula:

   Number_of_pulses = [Ne * V * I * |PF | * t] / [3600 * kT]

   Where:

   Ne = number of metering elements used

   V = test point voltage in volts [V] per phase

   I = test point current in amps [A] per phase

PF = power factor

kT = pulse constant programmed in the meter under test in Wh/pulse

t = test duration in seconds [s]

The result of the calculation should be rounded up to the nearest integer number of pulses.

Example:

Calculate the number of pulses required for an Inductive Load 3-phase test point with test duration of 60s; the source is configured to use V=120V, I=5A, PF=-0.5; the pulse constant of the tested ION8600 is kT = 1.8 Wh/pulse

Number_of_pulses = [3 * 120V * 5A *0.5 *60s] / [3600s * 1.8 Wh/pulse] = 8.3(3)

Round the number up to the nearest integer: Number of pulses = 9

10. Calculate error.

For every test point:

Energy Error = [(Em - Es)/Es] x 100%

Where:

Em = energy measured by the meter under test

Es = energy measured by the reference meter or the energy standard

# Typical Sources of Test Errors

If excessive errors are observed during verification testing, the test setup should be examined to eliminate typical sources of measurement errors:

- Loose connections of voltage or current circuits; often caused by worn-out contacts or terminals. Inspect terminals of the test equipment, cables, test socket and the meter under test.
- Meter ambient temperature significantly different than 23°C (73°F). See “Environment” on page 4 for an explanation.
- Floating (ungrounded) neutral voltage terminal in single-phase test configuration or in any configuration with unbalanced phase voltages. See Test Configuration examples on page 6.
- Operation of the optical sensor: sensitivity or ambient light problems.
- Unstable signal source. See “Power source” on page 3 for an explanation.
- Incorrect test setup: not all phases connected to the reference meter or the energy standard in poly-phase test configuration. All phases connected to the meter under test should be also connected to the reference meter/standard.
- Presence of moisture (condensing humidity), debris or pollution inside the meter under test.

# Test Settings

When testing the meter, ensure the test parameters are suited to your testing methods. You may need to adjust the front panel LED pulse rate and the test mode time-out.

**NOTE**

If the maximum pulse rate is exceeded the WATT LED remains on (does not blink).

The ITC (Instrument Transformer Compensation) operation should be disabled during the meter energy accuracy verification (Disable PT and CT compensation by configuring the “Ratio Correction Type” and “Phase Correction Type” setup registers in all ITC modules to “None”).

## LED pulser settings

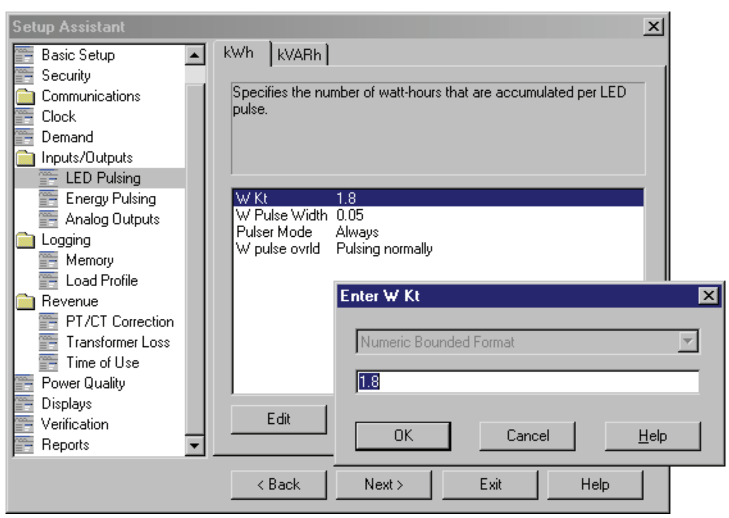
The WATT and VAR LEDs on the front panel are preconfigured for energy pulsing. The adjacent smaller infrared outputs are connected to the LEDs and pulse at the same rate. You may need to increase the Kt value if the LED does not pulse.

### Changing the LED pulse rate from the Front Panel

You cannot change the LED pulse rate from the meter’s front panel.

### Changing the LED pulse rate in ION Setup

1. Open the Setup Assistant in ION Setup.
2. Select the LED Pulsing screen.




3. Edit the Kt (Wh/pulse and VARh/pulse) values as desired.

### Changing the LED pulse rate in Designer

1. Open the meter using Designer software and double-click the Energy Pulsing Setup folder.

2. Right-click the Calibration Pulser LED module you want to modify.
3. Double-click the Kt register, make your change and click OK.
4. Click the Save icon (or choose Send & Save from the File menu).

The value entered defines how much energy the module accumulates before a pulse is sent to the hardware channel. The front panel WATT and VAR LEDs are factory set to the same pulse rate. The default Kt value is shown on the front panel label of the ION8600 meter and depends on the meter's form factor and current input option.

The pulse rates are summarized below:

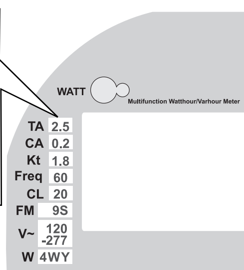
| Form Factor | Current Input Option | Default pulse rate for WATT LED | Default pulse rate for VAR LED (Kt) |
|---|---|---|---|
| 9S, 39S, 36S, 76S meters | 1A | 0.18 Watt-hours per pulse | 0.18 VAR-hours per pulse |
| | 5A | 1.8 Watt-hours per pulse | 1.8 VAR-hours per pulse |
| 5S, 35S meters | 1A | 0.12 Watt-hours per pulse | 0.12 VAR-hours per pulse |
| | 5A | 1.2 Watt-hours per pulse | 1.2 VAR-hours per pulse |

# Test Points

**NOTE**

It is recommended that you test the ION8600 meter at Full and Light Loads.

Nominal current is found on the meter's front panel.




### Watt-hour test points - Example

| Watt-hour Test Point | Specifications |
|---|---|
| Full Load | 100% of the nominal current, 100% of the nominal voltage and nominal frequency at unity power factor, or one (1).[1] |
| Light Load | 10% of the nominal current, 100% of the nominal voltage and nominal frequency at unity power factor, or one (1). |
| Inductive Load (Lagging Power Factor) | 100% of the nominal current, 100% of the nominal voltage and nominal frequency at 0.50 lagging power factor (current lagging voltage by 60° phase angle). |

1 The nominal current is found on the ION8600 meter front panel label.

### VAR-hour points - Example

| VAR-hour Test Point | Specifications |
|---|---|
| Full Load | 100% of the nominal current, 100% of the nominal voltage and nominal frequency at zero power factor (current lagging voltage by 90° phase angle).[1] |
| Light Load | 10% of the nominal current, 100% of the nominal voltage and nominal frequency at zero power factor (current lagging voltage by 90° phase angle). |
| Lagging Power Factor | 100% of the nominal current, 100% of the nominal voltage and nominal frequency at 0.80 lagging power factor (current lagging voltage by 30º phase angle). |

[1] The nominal current is found on the ION8600 meter front panel label.